Younger Dryas cooling led to a significant decrease in spruce and increase of tundra- and steppe-like vegetation after 12.6 cal ka BP. The Younger Dryas/Holocene boundary (*c*. 11.2 cal ka BP) is characterized by a sharp transition from the tundra-steppe communities to birch dominated forests. Pine forests dominated 9.0-8.1 cal ka BP. The most favourable climatic conditions for thermophilic taxa existed between 8.1 and 5.5 cal ka BP. The decrease of tree pollen taxa (especially *Picea*) and the increase of herbs after last 2.2 cal ka BP probably connects with anthropogenic activity. The presence of Cerealia and ruderal herb pollen is permanently recorded since ca 0.8 cal ka BP.

The thickness of the lacustrine sediments in Lake Bol'shoe Shuch'e (Polar Urals) was 54 m. According to the previous studies, most of the study area has remained ice-free over the last 50-60 ka. However, the configuration and timing of the preceding glaciations has remained unclear, because of lack continuous, long-term paleoenvironmental records in the area. Preliminary pollen studies (Fig. 1) show that the sediments between 25 and 54 m were accumulated during the MIS 3, when treeless tundra- and steppe-like communities with some dwarf birches dominated the area; sediments between 11 and 25 m - in MIS 2, when only tundra- and steppe-like grew in the lake vicinity; sediments between 11 and 9 m - in Allerød warming which is characterized by drastic increase in shrubby birch and willow communities; sediments between 11 and 9 m - in Younger Dryas, when birch communities decreased; the uppermost 9 m were accumulated in the Holocene, which pollen spectra reflecting the gradual forestation of the area.

The thickness of the lacustrine sediments in Lake Levinson-Lessing (Taymyr) was ca 44 m. Preliminary pollen studies show that the sediments between 44 and 31.5 m were accumulated during the MIS 3, when treeless tundra- and steppe-like communities with few dwarf birches dominated the area; sediments between 31.5 and 15 m - in MIS 2, when only tundra- and steppe-like grew in the lake vicinity. Numerous coprophilous fungi spores indicate the presence of grazing animals. Pollen assemblages in sediments accumulated in Allerød (15-8.5 m) reflect some increase in shrubby birch and, especially, in willow communities. Younger Dryas pollen assemblages (8.5-6.5 m) show that birch communities decreased. The uppermost 6.5 m were accumulated in the Holocene, their pollen spectra demonstrate gradual increase of shrubby vegetation in the area.

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LATE VALDAI PROGLACIAL LAKES OF THE UPPER VOLGA: GEOLOGICAL AND GEOMORPHOLOGICAL DATA

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Proglacial lakes are water bodies formed in periglacial zones. Two ways of proglacial lakes' possible origin are widely recognized in literature (Bylinskij, 1996; Kvasov, 1975). The first one was suggested by Kvasov (1975) who stated that the formation of these lakes was made possible because of river damming. When ice-sheets extended further onto the Russian mainland, north-flowing rivers were blocked, which resulted in appearing of ice-dammed lakes. On the other hand, according to Bylinskij (1996), factor that played the most important role in formation of proglacial lakes was the glacio-isostatic effect. It has long been recognized that horizontal mass transfer in the low viscosity asthenosphere due to glacial loading would have induced uplift and the formation of a peripheral bulge with its axis parallel to the ice sheet boundary. Glacio-isostatic forebulge affected existing fluvial systems which resulted in appearing of proglacial lakes.

Upper Volga basin supposedly could have been one of the regions where proglacial lakes emerged during the Late Valdai, as it was largely affected by the last glaciation event (Astakhov et. al., 2016). The idea of Upper Volga proglacial lake system was first introduced in 1975 by Kvasov. According to his calculations and predictions, the majority of Upper Volga territory has been covered by large lake system. The river itself was to appear only after lake system stopped existing. Presumably, it happened due to formation of a breakthrough valley near the town of Plyos, about 14,5k y.a. (Fig. 1) (Kvasov, 1975).

GIS modelling of Upper Volga proglacial lake system resulted in discovering that some of Kvasov's calculations are not to be considered completely trustworthy. Stated modelling was conducted according to Kvasov's data, such as change in lake system levels during different events of deglaciation. During Last Glacial Maximum (LGM) the Upper Volga proglacial lake system admittedly had two main outlets, both headed to the south. The first one was leading the waters of the system through river Klyazma, the second one – through river Teza. If we are to consider lake levels that were stated by Kvasov (1975), modelling shows that there was no possible way of the waters of the lake system to flow through river Klyazma. Yet river Teza still was confirmed as a possible outlet, according to GIS modelling. To examine this possible outlet more thoroughly, regional geologic and geomorphologic data were studied. The results of this study detected the complete absence of geomorphological and sedimentary evidence of lake waterflow through Teza outlet. Since river Teza valley is located lower than its surroundings, waterflow could not have occurred here only during one possible scenario: this passage was blocked by dead-ice. As the ice-sheet during the last glacial event did not reach this territory, Teza could have only been blocked during previous glacial event (170-125k y.a.). Considering everything stated earlier, we can assume that breakthrough valley of Volga near the town of Plyos was formed by the glacial meltwater outflow of degrading ice sheet.

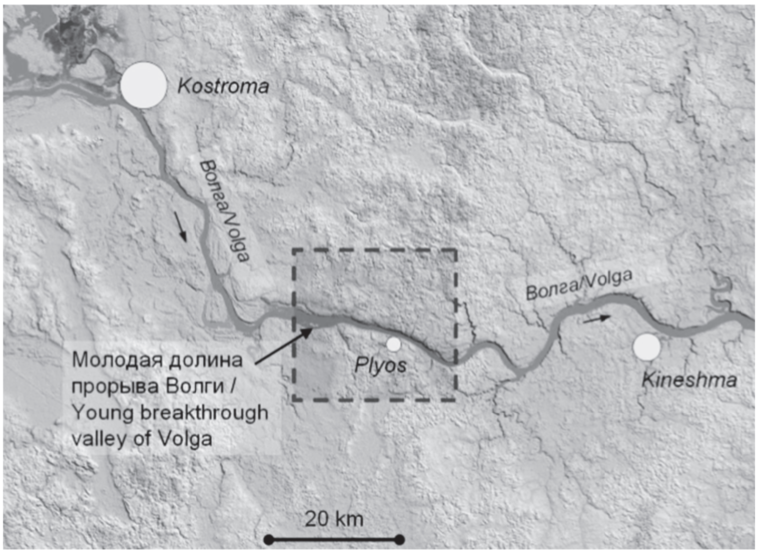

Fig. 1. Location of the breakthrough valley of Volga

The most important factor that could not have been considered by Kvasov and therefore was also neglected in previous study is glacio-isostatic adjustments. The role in valley development of crustal warping related to glacio-isostatic effects appeared through forebulge formation, as stated above. The reason we presume that forebulge could have affected Upper Volga is its close position to Valdai ice-sheet. The first one to indicate the possible effect of glacioisostasy on periglacial zone was Bylinskij (1996). Supposedly, glacio-isostatic adjustments could have been determinant in proglacial lakes' evolution of the Upper Volga region (Panin et al, 2015; Panin, Baranov, 2015). A new model of the last deglaciation event of the Late Quaternary ice age denoted as ICE-6G_C (VM5a) model was used to determine the glacio-isostatic effect on river Volga basin (Peltier, 2015). One of the predictions obtained from the model is topography difference from present. Using stated data allowed us to calculate the paleo topography of LGM. River Volga lengthwise section (Fig. 2) was used to visualize the changes in its structure. According to the given sections, glacio-isostatic adjustments did not affect the Volga valley as originally presumed. Forebulge was thought to distort the topography of the Upper Volga region in a way that it should have become tilted in the direction of the ice-sheet. The sections illustrate that instead glacial isostasy resulted in forming the parts of river Volga with an incline opposite to the current one, or even almost flat parts. The results indicate that both stated parts could have been covered with lakes.

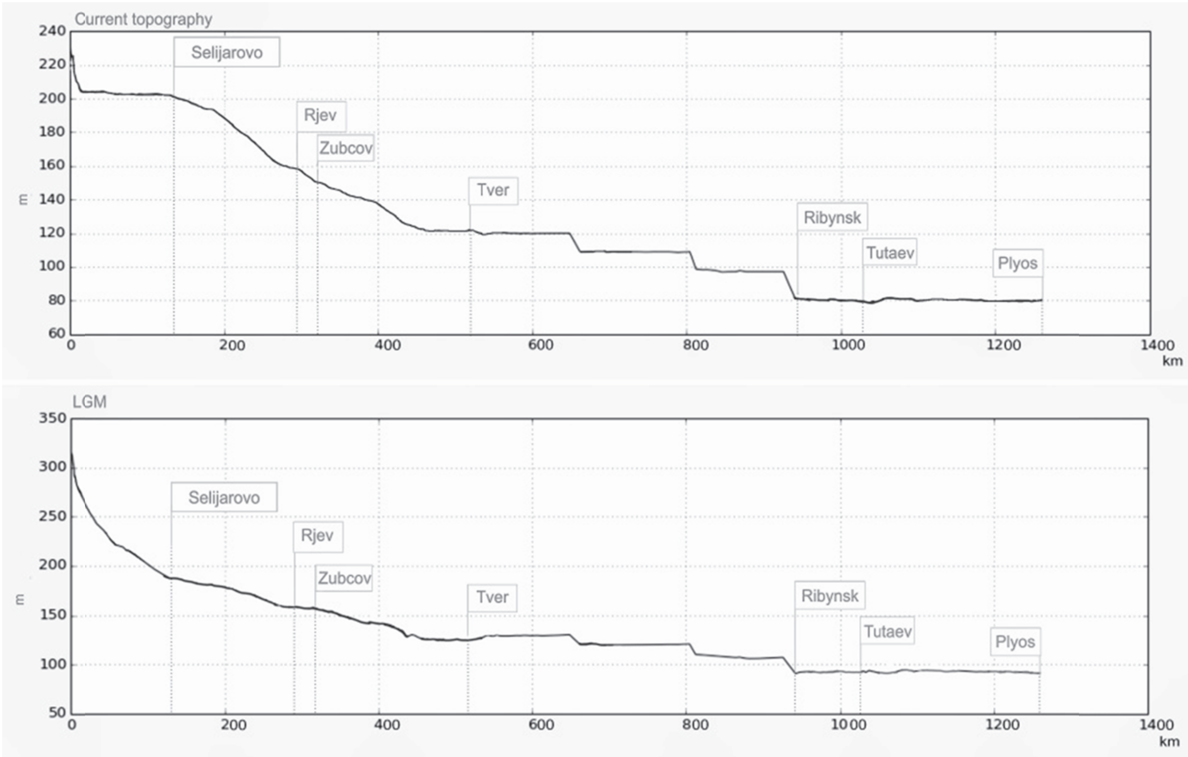

Fig. 2. River Volga lengthwise sections

Geological evidence of the proglacial lake existence is considered to be the widespread sandy-loam and loam deposits which are found near to the surface. These deposits have been indicated as in Yaroslavskoye Povoljie region (Rusakov, 2011), as in Tver oblast region (Kjamjarja, 2012). According to stratigraphic position, these deposits are commonly considered as Late Valdai deposits, however, there is no established opinion formed on their origin. Rusakov (2011) states that these Late Valdai deposits correspond to lacustrine deposits. Particle size distribution analysis was conducted using the multi-fractional scale of Baturin V.P. Analysed deposits were collected near the Bolshaya Kosha river in Tver oblast region. Starting from the surface and lower, until the 2 meters mark, studied section consists mostly of fine-grained sand and silt (fractions 0,1 – 0,05 and 0,05 – 0,005 mm) (80% of the whole mass). In the upper 0,5-0,7 meters the sediments are mixed, loose and unstratified, also the addition of medium-grained and fine-grained sand (up to 30% of the mass) is observed. From 0,7 to 2 meters deposits consist (up to 80% of the mass) of fine-grained sand and silt, while the fraction 0,05 – 0,01 mm (coarse-grained silt) makes up 50% of the mass. These deposits are well sorted and have thin stratification. The results show that described sediments should be classified as lacustrine deposits. Deposits of the upper 0,5-0,7 meters of the section are probably wind-borne after the lake stopped existing.

In conclusion, previously stated geological and geomorphological data can be described as a positive evidence of proglacial lakes existence in the Upper Volga region. The research was supported by RSF (project No. 17-17-01289).

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LATE PLEISTOCENE-HOLOCENE ENVIRONMENTAL AND CLIMATIC CHANGES IN THE BAIKAL REGION INFERRED FROM MULTI-PROXY LACUSTRINE RECORDS

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Humanity today lives in an unusual time. It is proved that greenhouse gas concentrations are increasing rapidly and are now much higher than they have been for at least 420,000 years. Global average temperatures exceed anything seen in the last thousand years. In general, climate on Earth naturally undergoes changes driven by external factors and internal causes. Natural forcing mechanisms will continue to operate and will play a role in future climate variations. By studying the records of climate variability and forcing mechanisms in the relatively recent past, it is possible to understand how the climate system varied under "natural" conditions, before anthropogenic forcing became significant. Lakes are one of the best objects for studying the climate of the past since they act as excellent "sentinels of change" (Williamson et al., 2009) by providing signals that reflect the influence of climate change in their much broader catchments. Their sediments provide natural archives for past environmental change. In many cases, the study of lake's bottom sediments (i.e., paleolimnology), and the biotic and abiotic components in particular, that combine information from the water column, catchment area, atmosphere, can help assess baseline conditions for different physical, chemical, and biological systems (e.g., climate, ecosystem development), as well as the recovery times after disturbances of ecosystems (Pienitz, Lotter, 2009).

A large share of paleolimnological research in Baikal Region has focused on climate records from lakes located in the vast areas of boreal taiga-forest and semi-arid areas of western Baikal Lake shore